

# Anytime Coach

## Your Ultimate MP3 Jukebox

SD 0725

Erin Beard

Paul Klapperich

Ronald Cummings

Sidhant Jain

Advisor: Joel Aslakson



# Overview

- What is Anytime Coach?
- Requirements
- Design & Schematics
- Demonstration
- Problems Encountered and Lessons Learned
- Budget
- Future Advancements
- Project Summary
- Question & Answers

# What is Anytime Coach?

- Pocket MP3 Player
  - Capable of superimposing one audio source over another
  - Music volume lowered to hear the voice-over
  - Used as “Virtual Personal Trainer” or “Virtual Tour Guide”
  - Capable of communicating with other devices

# Requirements

- 5 Line LCD Display
- Control Buttons for menu navigation
- 2GB flash card support
  - SD card
- Interfacing
  - RFID, Bluetooth / Wi-Fi

# Design

## ■ Microprocessor

- RCM3000 with Rabbit Core R3000
  - 8-bit CISC architecture
  - 256KB Flash, 128KB RAM

## ■ MP3 Decoder

- VS1011e – MPEG Audio
  - Capable of playing tracks up to 320kbit/s and VBR
  - In built high-quality stereo DAC
  - Headphone driver/amplifier

## ■ SD Card

- uALFAT Module and 2GB Micro SD Card
  - Supports UART, SPI, and I2C
  - Manages FAT16

# Design

## ■ RFID

### ■ Parallax RFID Reader Module

- Reads passive tags
- Range of 2" – 6"

## ■ Wi-Fi

### ■ Rabbit Semiconductor Wi-Fi add-on kit

- Linksys Wireless Compact Flash Card
  - 2.4 GHz

## ■ LCD Display

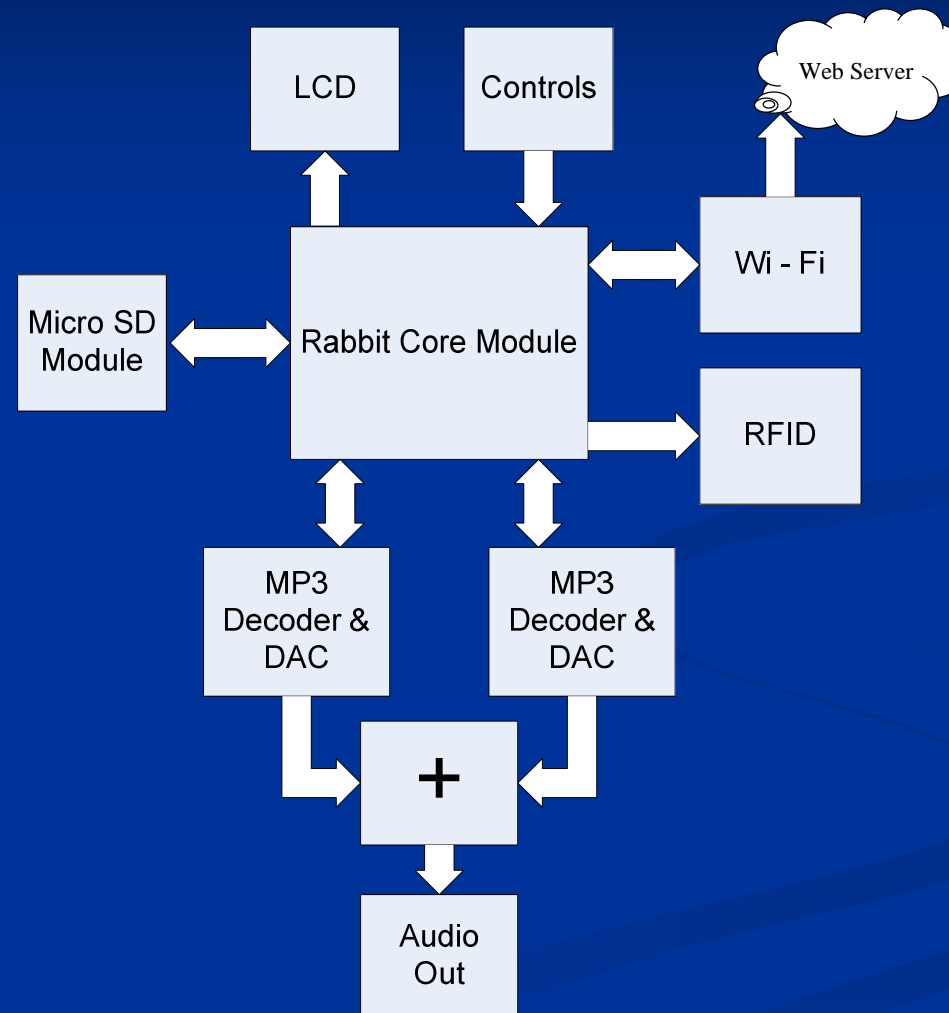
- Parallax Serial 20x4 monochromatic LCD

# Design

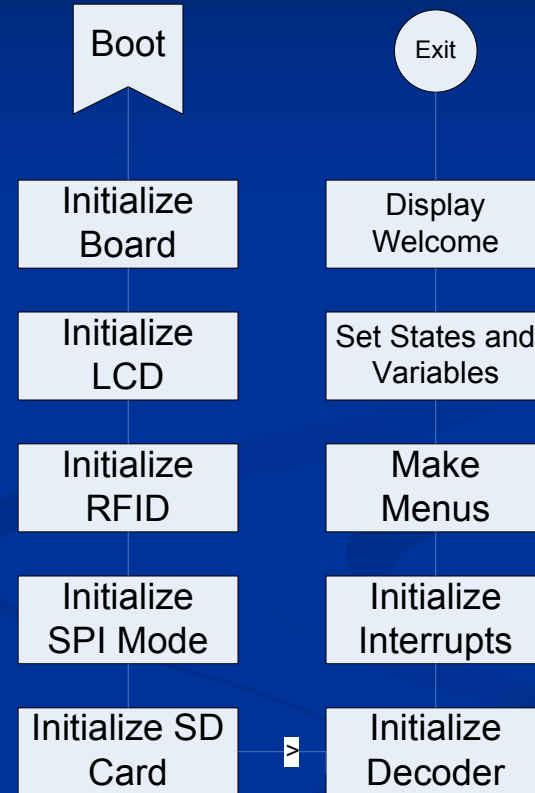
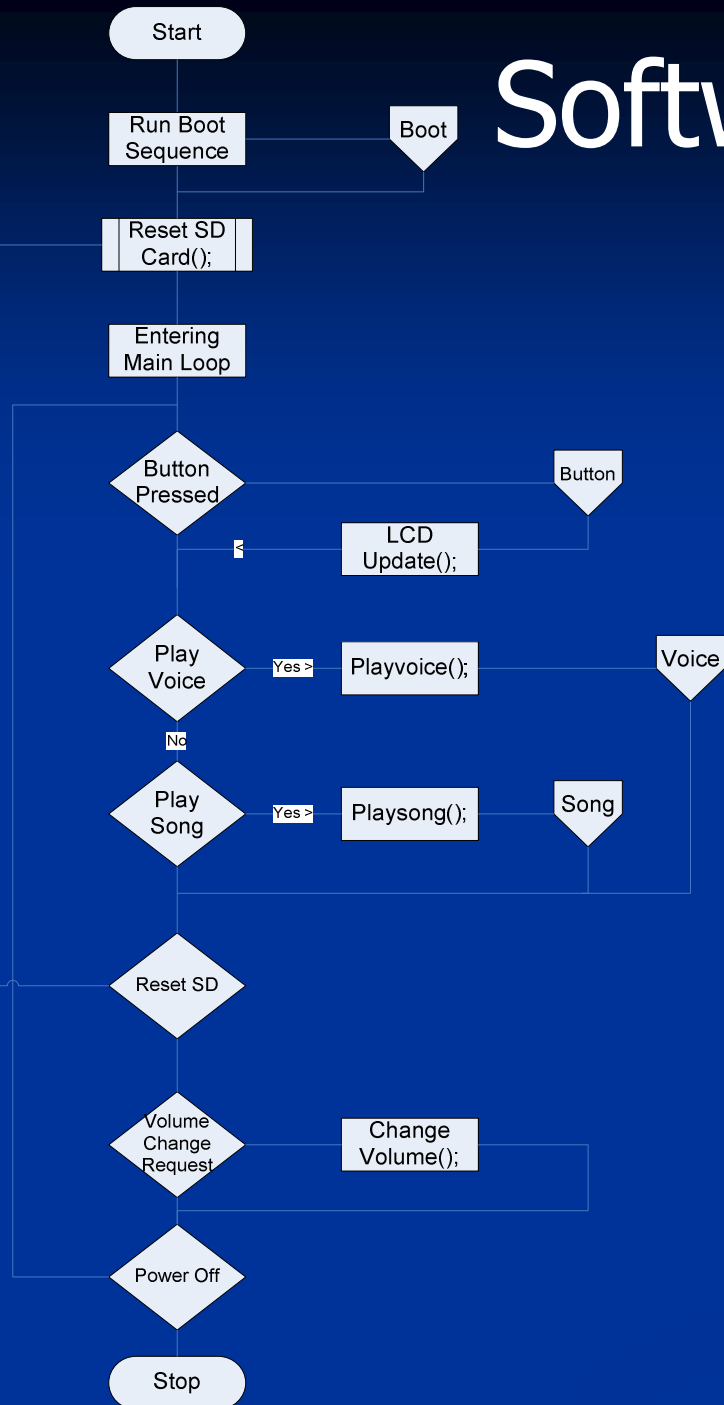
- Web Server
  - Database for Training
  - Using Apache, PHP and MySQL
- Power Supply
  - 4 AA Batteries
  - 5V external supply
- Buttons
  - Momentary push buttons for navigation



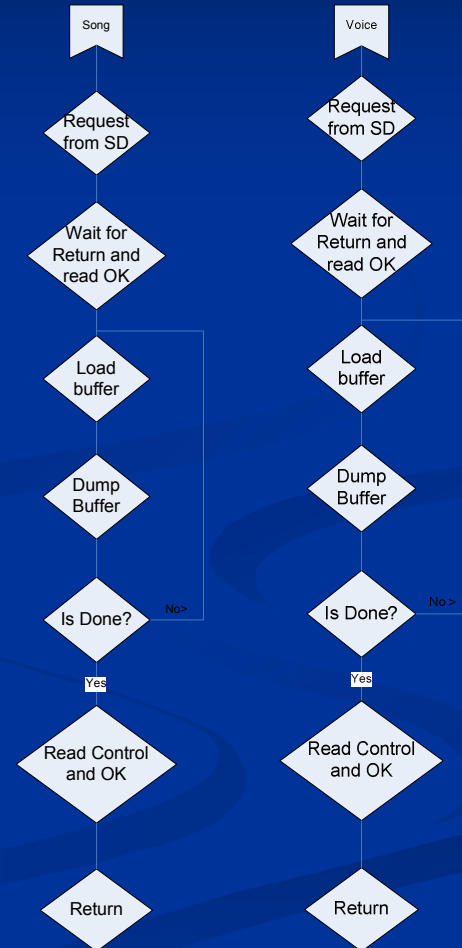
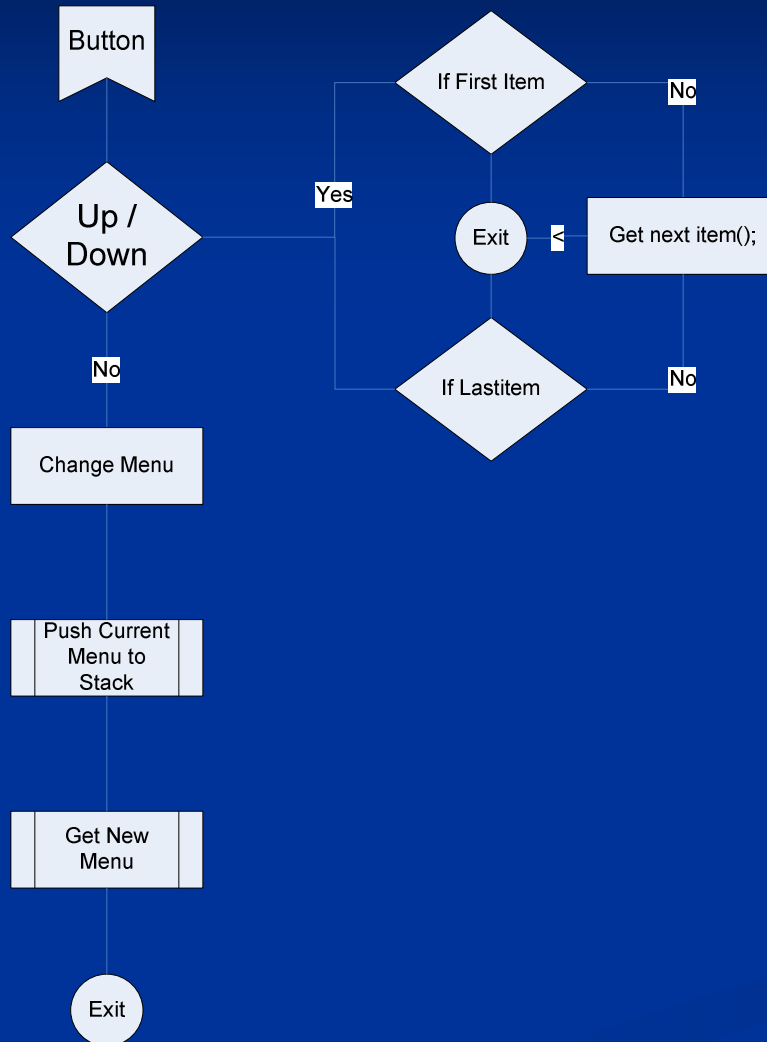
# Top-Level System Design



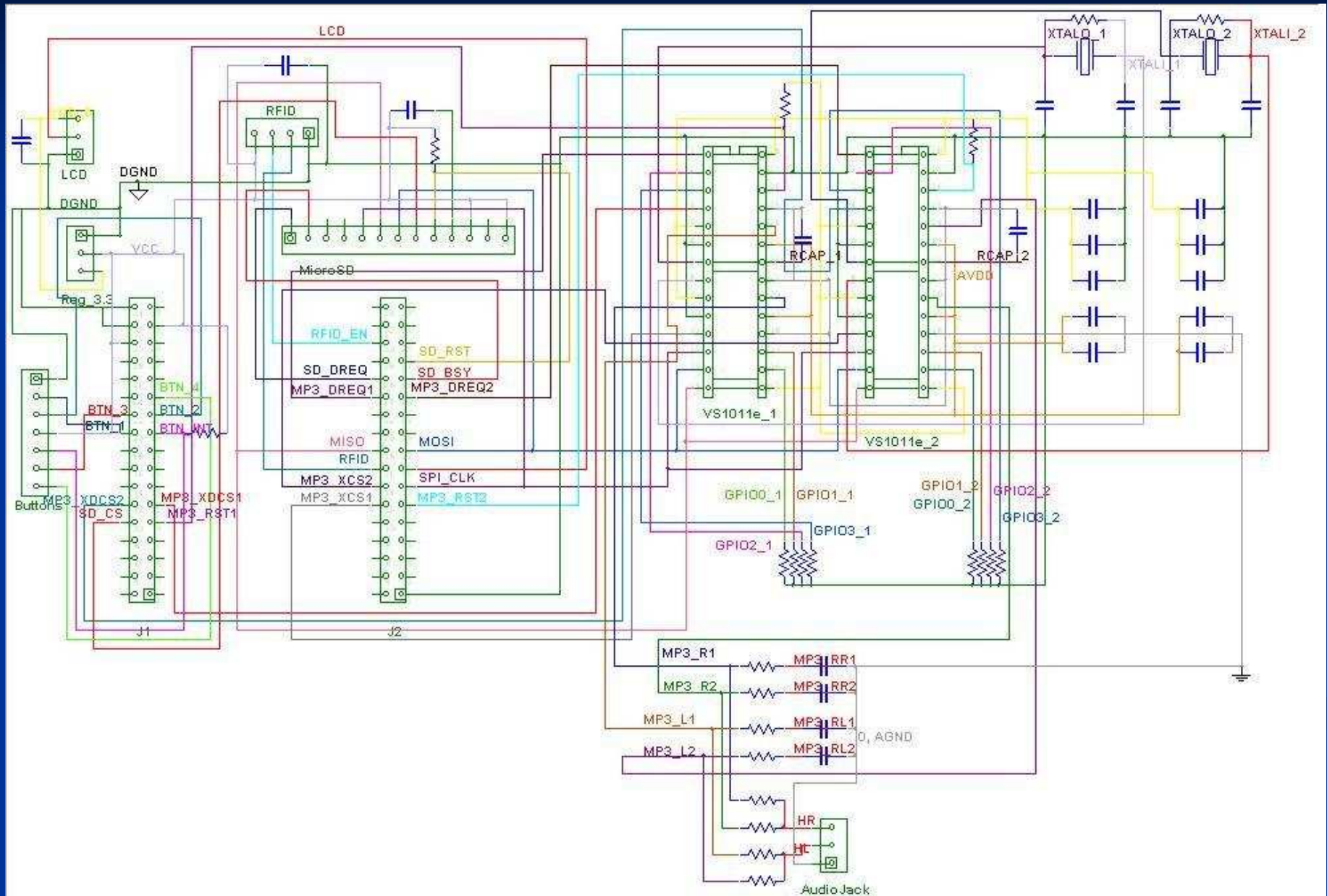
# Software Model



# Software Model



# Schematic



# Evaluation

- MP3 is frame based file format
- Frame size of 417 bytes for
  - 128 kbps
  - 44100 KHz
- Two files can be read in parts alternatively as frame based
- The decoder requires just binary data
- Files can be buffered into decoder

# Evaluation

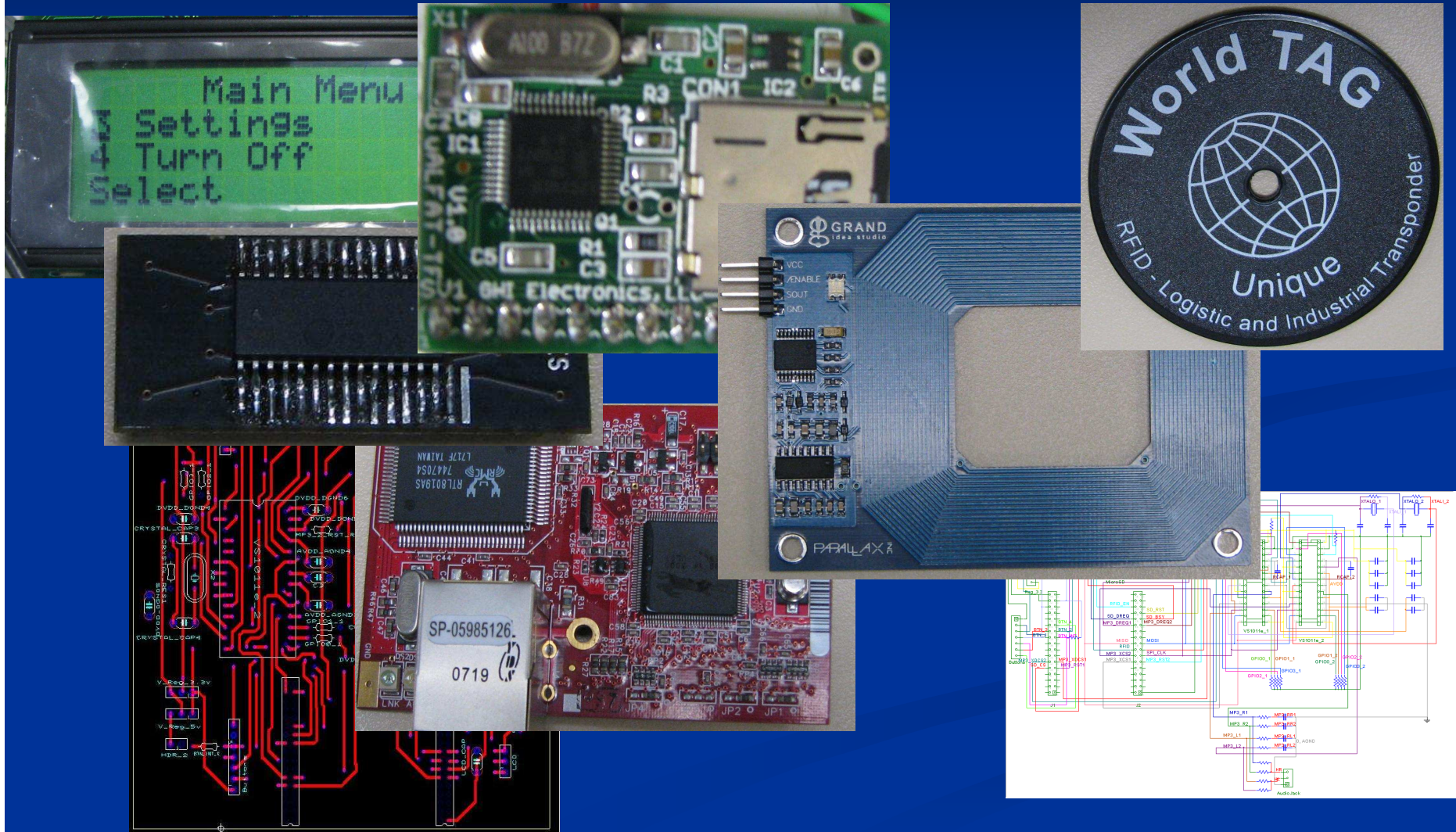
- Playing 2 files simultaneously is not currently feasible
- A 128kbps MP3 file = 16KB/s.
- MP3 decoders contain 5KB buffers
  - Buffer only holds 315ms of play time
  - SD Card module takes 80ms to respond to commands
  - This leaves only 155ms to read data in from both files and stream them back out to the MP3 decoders
- A large external RAM would alleviate this problem

# Testing

- RFID sensor senses the station tag
- Each station has unique tag
- Download data specific to the user & tag
- The device can then begin playing the specific training session audio file



# Pictures





# Demonstrations

# Voice Over

- Works on the principle of superposition
- Signals should be sampled at same frequency for audible quality
- The larger the amplitude of the signal the louder it is



Track 1



Track 2



Normal Voice  
-Over



Enhanced  
Voice-Over

# Problems Encountered

- SD Module
  - Data rate too low
  - Data mangling
- MP3 Decoder
  - Communication with device
- Rabbit Core
  - Ports switching from input & output
- Data Sheets
  - Difficult to interpret

# Lessons Learned

- Communication
- Always Unforeseen Problems
- Getting things working before creativity

# Budget

S. No.	Vendor	Part No	Description	Price	Quantity	Cost*	Acquired Cost*
1.	Digikey	497 – 3939 -1- ND	MP3 Decoder	17.14	2	34.28	34.28
2.	Digikey	A323- ND	Decoder Adapter	10.35	2	20.7	20.7
3.	Digikey	HR845CT – ND	SD Card Connector	4.67	1	4.76	4.76
4.	Digikey	ATMEGA – 8535 – 1GPU – ND	Microcontroller	5.7	2	11.4	11.4
5.	Digikey	ATAVRISP2 – ND	Programmer	35.91	1	35.91	35.91
6.	Digikey	CP – 3523SJCT – ND	Audio Jack	0.87	2	1.74	1.74
7.	Digikey	EG1301 – ND	Push Switch	2.15	2	4.3	4.3
8.	Digikey	EG1303 – ND	Push Switch	2.15	1	2.15	2.15
9.	Digikey	EG1308 – ND	Push Switch	2.15	1	2.15	2.15
10.	Circuit City	SDSDPH – 2048 - 901	SD Memory Card	34.99	1	34.99	34.99
11.	Newark	75K7350	D/A Converter	4.06	2	4.06	4.06
12.	Digikey	28141	Rectangle RFID Tag	2.75	3	8.25	2.75
13.	Digikey	28142	RFID Round Tag	2.75	4	11	2.75
14.	Digikey	28140	RFID Reader	39.95	2	79.9	39.95
15.	Digikey	28148	RFID Disc Reader	2.75	1	2.75	2.75

\*All values are in USD unless otherwise stated

# Budget Continued

S. No.	Vendor	Part No	Description	Price	Quantity	Cost*	Acquired Cost*
16.	E-Bay	N 73 OEM Joystick	Joystick	6.98	1	6.98	6.98
17.	Parallax	27979	LCD 20 x 4	46.68	1	46.68	46.68
18.	Sparkfun	BOB - 08215	DosOnChip Breakout	48.25	1	48.25	48.25
19.	Digikey	OP290G	IC OP Amp	5.98	1	5.98	5.98
20.	Digikey	NJM#210	IC OP Amp	0.6	2	1.2	1.2
21.	Digikey	S7120	Connection Header	1.93	4	7.72	7.72
22.	Digikey	497-3939	IC Decoder	17.14	2	34.28	34.28
23.	Digikey	S5750-17	Connection Header	3.48	2	6.96	6.96
24.	Digikey	MX7224K	IC DAC 8 - Bit	7.34	2	14.68	14.68
25.	GHI Electronics	uALFAT	SD Card Reader Module	60.65	1	60.65	0
26.	Sparkfun	BOB - 08215	SD Card Reader Module	65.4	1	65.4	0
27.	Sparkfun	VS1011e	MP3 Decoder	24.86	2	49.52	0
28.	PACTEC	ODN56-2.5	Enclosure	15.05	1	15.05	0
29.	PACTEC	ODN45-2.5	Enclosure	12.46	1	12.46	0
30.	Rabbit	101-0523	Rabbit Development Kit RCM3000	299	1	299	0

\*All values are in USD unless otherwise stated

# Budget Continued

S. No.	Vendor	Part No	Description	Price	Quantity	Cost*	Acquired Cost*
31.	Rabbit	RCM3000 Footprint	Wi-Fi Add-on Kit	199	1	199	0
Total						1134.74	377.37

\*All values are in USD unless otherwise stated

# Future Work

- Voice-Over Audio
  - 2<sup>nd</sup> Storage Device
- Functionality & Feasibility
  - Joystick
  - Size
  - Color LCD
  - Cost



